Deaths Due To Perinatal Conditions In Non-Anomalous Newborns In Utah - A Statewide Review For Two Calendar Years.

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INTRODUCTION:

Beyond the personal tragedy, infant mortality is an important indicator of a community's well being. The Utah Department of Health began a Perinatal Mortality Review Program (PMRP) in 1995, the objectives of which were to provide timely and pertinent statewide data on perinatal health, to develop an efficient and practical review process and to make recommendations for improvement of pregnancy outcomes. This manuscript reports the first two years experience of this program as well as the initial recommendations of the Program for improvement of pregnancy outcomes.

METHODS:

Potential perinatal cases for review were identified by the Utah Department of Health via a concurrent linkage review of birth certificates with death certificates containing International Classification of Disease, 9th Revision (ICD-9) codes 760-779.9. All non-anomalous infants who died of perinatal conditions were reviewed (except those who died of SIDS).

The PMRP Coordinator (L.B.) identified cases for review by screening all linked death/birth certificates of infants who died in Utah during 1995 and 1996. Of the 456 infant deaths that occurred during those years, 185 (40.6%) cases fulfilled review criteria. These 185 cases represent 170 pregnancies (11 sets of twins, 2 sets of triplets). Access to medical records was procured through the Utah Code, Chapter 25 section 26-25-1 which grants authority to provide data to the Department of Health on treatment and condition of persons for study with the purpose of reducing morbidity or mortality. All committee members signed agreements to maintain confidentiality of cases reviewed as set forth in the Code.

Data were abstracted from infant and maternal medical records using field tested tools provided by the National Fetal-Infant Mortality Review (NFIMR) Program. Cases were summarized and reviewed by the Committee on a monthly basis. Every case was reviewed and contributing factors that may have led to the death were identified. Recommendations and strategies identified to prevent future deaths were recorded.

Infant mortality rates (infant deaths/1000 live births) were examined across various categories of potential risk. The chi square test of independence was used to examine the statistical significance of bivariate association between each independent variable and infant mortality. Finally, for the variables showing statistically significant association through chi square, we evaluated the strength of association between the risk factors and infant mortality by computing phi-coefficient (for dichotomous independent variables) and Cramer’s V (for categorical variables with more than two response categories). These two

statistical procedures are frequently used in health care research for similar queries.[1,2,3]

RESULTS:

Maternal ages ranged from 15 to 40 years, with a mean age of 25 years (N.S. versus entire birth population). Seventy-five percent of mothers of infants in the study group were married. Infant mortality rate was higher for unmarried mothers than for married mothers (3.4 versus 2.0/1000 live births, $p<=0.05$).

Educational levels of mothers ranged from four years to 17 years with a mean of 12.8 years. Infant mortality rate by level of education for the study group was higher for mothers with less than a high school education (3.1/1000 live births) than for those who had attended college (1.9/1000 live births). Maternal education below high school was associated with significantly increased risk of infant mortality ($p<=0.05$).

The majority of the study infants (175 of 185, 94.6%) were white, including 21 infants of Hispanic origin. Only ten of the 185 infants reviewed were of minority race, one was Black, three were Native American, three were Asian/Pacific Islander and three were of mixed race. None of these groups were disproportionately represented or underrepresented in comparison to the overall birth population.

Seventy-one infants (42%) were delivered of primigravidas. Infant mortality rate was increased in primigravidas (2.9/1000 live births) and grand-multiparas (3.4/1000 live births) in comparison to women having their second, third or fourth deliveries (1.4/1000 live births). The relationship between parity and infant mortality was statistically significant ($p< =0.01$).

Pregnancy history of study mothers included approximately 30% who had experienced one or more spontaneous or induced abortions. This compares to 22% of the general birth population in Utah during the study period who experienced one or more spontaneous or induced abortions.

The infant mortality rate was higher for rural residents (2.4/1000 live births) than urban residents (2.0/1000 live births), however, this difference was not statistically significant.
Infant mortality rate was highest for the 24 out-of-state residents reviewed (9.9/1000 residence specific live births), reflecting the acuity of maternal transport cases.

In Utah during the study period, 68,164 (83%) women who gave birth entered prenatal care during the first trimester. A lower percentage (76%) of study group mothers entered prenatal care during the first trimester. Prenatal care in the first

trimester was statistically significantly associated with a lower risk of infant death ($p<=0.01$). During 1995 and 1996 only 352 (0.4%) women giving birth in Utah received no prenatal care. However, 4.9% (8) of the study group received no prenatal care.

Infant mortality correlated with maternal pre-conceptional weight, being higher for mothers in the lowest pre-pregnancy weight category (less than 120 pounds, 2.5/1000 live births) and highest weight categories ($\geq$ 200 pounds,3.7/1000 live births) than in those women whose pre-conceptional weight was between 120 and 199 pounds (1.8/1000 live births). Low and high pre-conceptional weight was statistically significantly associated with increased risk of infant mortality ($p<=0.01$).

Pregnancy complications were associated with most of the infant deaths included in this review, by far the most common being premature labor and delivery. Of the 170 mothers studied, 65% (112) experienced premature delivery. Placental problems occurred in 28% (48) and preterm rupture of membranes occurred in 21% (36) of mothers studied. Thirty-two (19%) of women experienced chorioamnionitis.

Multiple gestations are at risk of increased perinatal mortality due to preterm birth, twin to twin transfusion and other complications. The PMR study group included 40 infants who were products of multiple gestations; 33 of whom were twins and 7 of whom were triplets. There were 11 pregnancies in which both twins in the set died. The study group included only 1 full set of triplet deaths, as well as one set in which 2 or the 3 died. The infant mortality rate for multiple gestation births (19.7/1000 live births) was significantly higher than for singleton gestation births (1.8/1000 live births) ($p<=0.001$).

Tobacco use during pregnancy was reported for approximately 14% of mothers included in the review. This is higher than the 9% reported for the total birth population in Utah. The infant mortality rate for infants of mothers who reported smoking during their pregnancy was higher (3.1/1000 live births) than that of non-smokers (2.1/1000 live births), however, this difference was not statistically significant.

The majority of infants reviewed were born vaginally. However, infant mortality rate among cases reviewed was significantly higher ($p<=0.001$) for those infants born by primary cesarean section (53, 6.8/1000 live births) compared to those born by repeat cesarean section (14, 2.6/1000 live births) or those born vaginally (103, 1.4/1000 live births). This finding may be attributable to the fact that the cesarean sections were performed as an attempt to promote a better outcome in higher risk infants.

Data were available regarding birth attendant on 166 of the 170 maternal records reviewed; 161 of these infants were delivered by a physician, one by a certified nurse midwife and one by a lay midwife. Three infants were delivered precipitously, unattended in the hospital, all at 21 weeks gestation.

The gestational age of infants included in the study group ranged from 20 to 41 weeks with a mean of 26 weeks. Birth weight for infants ranged from 170 grams to 4139 grams; 81% of infants reviewed were very low birth weight (VLBW, less than 1500 grams) infants. Birth weight specific infant mortality rates decrease dramatically as birthweight increases (349.4/1000 live births for birthweights < 1000 grams, 20.7/1000 live births for birthweights 1000-1499 grams, 7.1/1000 live births for birthweights 1500-1999 grams, 1.7/1000 live births for birthweights 2000-2499 grams and 0.3/1000 live births for birthweights $\geq$ 2500 grams). The association between infant death and both gestational age ($p<=0.001$) and birthweight ($p<=0.001$) was strongly statistically significant.

Eighty-two percent of infants included in the study group died within the first week of life with two-thirds of this group dying during the first 24 hours of life. Age at death ranged between 0 and 51 weeks with a mean of 2.5 weeks. Perinatal conditions were grouped by ICD-9 codes to determine cause of death categories. Table 1 indicates cause of death categories by ICD-9 codes assigned on the death certificate of each infant.

The study group included 106 study infants born between 23 and 36 weeks' gestation making them possible candidates for maternal corticosteroid administration to improve lung maturation and decrease the risk of respiratory distress syndrome. Of the infants eligible, 59 (56%) received appropriate corticosteroid treatment.

Five major categories of associated factors were identified, including pregnancy related socio-demographic issues, maternal health factors, medical care provider issues, health care facilities issues and health systems issues (Table 2). Preventability was also considered. In 130 pregnancies (76%) there was thought to be no chance that the outcome could have been altered. However, in 28 (16%) of cases reviewed the committee deemed there was "some" chance, in 4 (2.3%) there was a "good" chance, and in 8 (4.7%) there was a "strong" chance that outcome could have been altered.

During each case review any recommendations for management of similar cases were recorded. These recommendations are listed in Table 3.

DISCUSSION:

The finding of a statistically significant increase in infant mortality rates among primigravidas and grand-multiparas included in our study requires further

research. Several previous studies have found a statistically significant interaction between parity and age such that mothers over 34 years old having their first birth were at especially high risk of neonatal mortality.[4,5] Our study group contained only one mother who was over the age of 34 years and a primigravida. In another study, Tanbo and Bungum demonstrated a tendency towards increased frequency of preterm delivery among grand-multiparas due to an increased occurrence of abruptio placenta and placenta previa.[6] Our data confirm these observations. Our study group included a higher percentage of grand-multiparas who experienced placental complications (28.5%) versus a lower percentage of non grand-multiparas (0-4 previous pregnancies), (21.6%) who experienced placental complications. Our study group consisted of 13% grand-multiparas women versus 8.3% grand multiparas in the entire birth population during the study period.

Entry into prenatal care is considered a marker for healthy outcomes.[7] According to U.S. Health & Human Services, National Center for Health Statistics 1994 data compiled by the Children's Defense Fund, Utah ranked ninth best out of the 50 states and the District of Columbia in the percentage of women who enter prenatal care during the first trimester.[8] According to 1995 and 1996 Utah birth certificate data, 83% of women who gave birth entered prenatal care during the first trimester. A lower percentage (76%) of the mothers included in the study group entered prenatal care during the first trimester. An extremely high risk group are those women who do not seek prenatal care at all. During 1995 and 1996 only 0.4% of women giving birth in Utah received no prenatal care. Of women included in the PMR study group a much higher percentage (4.9 %) received no prenatal care. Further research is required to determine reasons why women do not seek prenatal care.

The nutritional level at the time of conception is known to affect the incidence of preterm delivery. Data from the 1980 National Natality Survey indicated that the percentage of low birth weight was highest among women with the lowest pre-pregnancy weights and lowest prenatal weight gains.[9] According to an analysis of a large sample of pregnancies evaluating the relationship of mother's pregravid body weight to pregnancy outcome progressively increasing mortality rates occurred in offspring as mothers' weight increased.[10] A more recent study has found that among nulliparous women, the risk for very preterm delivery (<33 wks.) and early neonatal death was significantly increased for obese women.[11] Our data confirm these observations. Naeye[10] also reported that nearly half of this mortality increase was due to preterm deliveries and that more than half of the increase in preterm births was caused by acute chorioamnionitis, a finding that has been recently expanded.[12]

Almost 19% (32) of mothers of infants included in the PMR study group experienced clinically apparent chorioamnionitis as a complication of pregnancy. The most common pregnancy complication associated with the infant deaths

included in this review was premature labor and delivery (65% or 112 mothers), (Table 1). Despite abundant new knowledge about the factors that underlie preterm birth, rates remain static. According to a recent editorial in the New England Journal of Medicine, “there is growing evidence that subacute or even chronic pathophysiologic changes precede an eventual clinical diagnosis of preterm labor or preterm rupture of the the membranes. Findings of inflammatory cytokines in second trimester amniotic fluid, fetal fibronectin expression in cervicovaginal mucus, cervical shortening as seen on ultrasonography, and increased concentrations of maternal salivary estriol, all detected weeks to months before a preterm birth, provide persuasive evidence that spontaneous preterm birth is the result of a long term process.”[13] It is therefore incumbent on prenatal care providers to identify women at risk for preterm birth and then, utilizing the aforementioned tests. screen and treat appropriately in order to prevent preterm birth.

The PMR committee developed recommendations to prevent future like infant deaths, based on identified factors that may have contributed to the infant deaths reviewed (Table 3). Strategies which have incorporated these recommendations are currently being developed and implemented, including, opportunities for public and perinatal healthcare provider education. The PMR committee continues to review infant deaths on an ongoing basis in an effort to improve perinatal outcomes in the state of Utah.

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Table #1 **STUDY GROUP INFANT DEATH CAUSES BY CATEGORY, UTAH, 1995 & 1996**

Cause of Death Category	ICD-9 Code	Number of Infants	% of Total Study Group
Prematurity	765	61	33%
Maternal Causes	760-763	43	23.2%
Perinatal Infections	771	18	9.7%
Respiratory Distress Syndrome	769	15	8.1%
Digestive Disorders	777	12	6.5%
Other Respiratory Disorders	460-519 & 770	12	6.4%
Hypoxia/Asphyxia	768	7	3.8%
Birth Trauma	767	6	3.2%
Other Infectious or Parasitic Diseases	001-139	5	2.7%
Ill Defined Perinatal Conditions	779	2	1.1%
All Other Causes	Residual	4	2%

Table #2 FACTORS ASSOCIATED WITH INFANT DEATHS

Pregnancy Related-Socio Demographic Issues:	**Frequency**
delay or failure to seek care	34
poverty	34
teen pregnancy	25
unmarried	25
smoking	21
substance use	12
limited understanding, lack of knowledge	9
unintended pregnancy	7
lack of patient follow through on care plan	5
language barrier	3
mental illness	2
Maternal Health Factors:	
obesity	24
urinary tract infection	17
low prepregnancy weight	11
infertility	8
short interpregnancy interval	4
hypertension	4
history of previous stillbirth	3
history of previous preterm birth	2
anemia	2
sexually transmitted disease	2
Medical Care Provider Issues:	
delay or lack of diagnosis or treatment	13
mismanagement	13
misdiagnosis	7
poor communication with other providers	7
failure to seek consultation	6
lack of risk assessment	4
incomplete records	4
use of ineffective treatment	3
poor continuity of care	2
inaccessibility/shortage	2
Health Care Facilities Issues:	
inadequately trained personnel	5
unavailable facilities	4
delayed transportation to tertiary care	1
communication/coordination problems	1
Health Systems Issues:	
uninsured	12
services unavailable	2
lack of coordination of services	2

Table #3

CRT Recommendation	Number of Cases for which recommendation was made
Providers need to consider genital tract and urine cultures and administration of appropriate antibiotics in clients with signs and symptoms of preterm labor	7
Need for providers to consult perinatologist and neonatologist in a timely manner in high risk cases	7
Transport of high risk moms and infants to tertiary care issues; candidates need to be appropriately screened, transport needs to be accomplished in a timely manner, and transport team needs to be adequately equipped	7
Strict and timely adherence to the CDC recommended protocol for the prevention of neonatal early onset group beta strep	6
Increased provider use of appropriate antepartum maternal and fetal assessment (including genetic testing)	6
Clients need to notify prenatal care provider immediately when danger signs of pregnancy are noted.	5
Prompt recognition and response by providers to signs of fetal distress	5
Every facility delivering newborns needs to assure that staff are current in newborn resuscitation skills	5
Hospitals need sufficient facilities and staff to comply with the ACOG standard of 30 minutes between decision and incision for emergency cesarean sections	4
Appropriate administration of intrapartum antibiotics	3
Increase public awareness of the importance of early prenatal care	3
Accurate vital records reporting by providers; infants born with apgars of 0/0 should not be reported as live births	2
Newborn nursery staff need to adhere to AAP recommendations for infant stabilization	2
Public education regarding the importance of and procedure for fetal movement counts	1
Adherence to ACOG standards for the use and administration of Pitocin to augment labor	1
Availability of family planning to clients in need	1
Providers need to perform versions as inpatient procedures so that protocols that call for fetal assessment prior to and following version can be appropriately carried out	1